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Title:

**SPORTING RACKET**

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# DESCRIPTION

## Sporting Racket

[Field of the Invention]

The present invention relates to a sporting racket using strings in a hitting area in tennis, badminton, etc. More particularly, the present invention relates to a racket that allows the tension of stretched strings to be changed (or adjusted) in an appropriate and easy manner.

[Background Art]

Rackets for tennis, badminton, etc do not provide satisfactory tension of the strings stretched therein depending on the rigidity of the frame, the size of the face (size of the hitting area), the repulsive force of the strings, the preference of a player, etc. In such a case, the user must put up with the unsatisfactory tension or must stretch the strings again until a desired tension is obtained.

Current users of such rackets also face a situation in which the strings cannot be always maintained to have a desired tension due to the initial elongation of the string itself and the change by the repeated use.

**[Disclosure of the Invention]**

The present invention has been made in view of the above and

has an objective of providing a racket capable of easily adjusting the tension of the strings in a simple structure.

According to a first aspect of the present invention, there is provided a racket including a loop-shaped frame body having an inner surrounded region in which strings are stretched in a net shape to provide a hitting area; and a shaft section having a grip section gripped by a player, at a tip end section thereof, the racket comprising: a plurality of string holes provided in the frame body to allow the strings to be folded back therethrough; and a string tension adjustment member provided between the string holes positioned to be adjacent to each other to form a string folding portion and configured to allow the string to be folded in a desired position, wherein the string tension adjustment member includes columnar member having a string-contact face on a peripheral face thereof, and a distance from a rotation center of the string tension adjustment member to the string-contact face is variable.

In accordance with the racket structured as described above, the string tension adjust member can be operated to allow the string to be easily adjusted to have a desired tension.

In the racket, when the string-contact face is provided in a tapered helical manner on a peripheral face of the columnar member, the tension can be continuously changed to become a desired one. In this case, this columnar member may be made of a resin, metals such as aluminum, wood, or ceramics.

When the string-contact face in the racket is formed by a

screw groove, a structure which is simple and that has a high reliability is achieved.

According to a second aspect of the present invention, there is provided a sporting racket including a loop-shaped frame body having an inner surrounded region in which strings are stretched in a net shape to provide a hitting area; and a shaft section having a grip section gripped by a player, at a tip end section thereof, the racket comprising: a plurality of string holes provided in the frame body to allow the strings to be folded back therethrough; and a string tension adjustment member provided between the string holes positioned to be adjacent to each other to form a string folding portion and configured to allow the string to be folded at a desired position, wherein the string tension adjustment member has a screw mechanism configured to change a position at which the string is folded.

Thus, according to the racket having the structure as described above, the string tension adjustment member functioning as the screw mechanism can be operated to easily adjust the strings of the racket to have a desired tension.

The racket as described above is superior to the racket according to the first invention in that the wedge action by the screw (force doubling action) can be used to easily change the force of the string.

When any of the rackets has a yoke section and the string tension adjustment member is disposed at the yoke section, a structure preferable from the viewpoint of practicality is obtained.

**[BRIEF DESCRIPTION OF THE DRAWINGS]**

Fig. 1 is a view showing the entire structure of a tennis racket that is one type of sporting rackets according to an embodiment of the present invention;

Fig. 2 is a partially enlarged perspective view illustrating a yoke section of the racket shown in Fig. 1;

Figs. 3(a), 3(b), and 3(c) are views showing the structure of a string tension adjustment member provided in the yoke section of Fig. 2, wherein Fig. 3(a) is a side view of the string tension adjustment member, Fig. 3(b) is a view taken in the direction of arrows along line IIIb-IIIb of Fig. 3(a), showing a helical string-contact face of the string tension adjustment member of Fig. 3(a), and Fig. 3(c) is a cross-sectional view taken along line IIIc-IIIc of Fig. 3(a) in which the string tension adjustment member shown in Fig. 3(a) causes the string to be in contact with a string folding position with the minimum tension;

Figs. 4(a) and 4(b) are partially enlarged perspective views of the string tension adjustment member with the string tension adjustment member shown in Figs. 3(a), 3(b), and 3(c) provided in the yoke section of the racket, in which Fig. 4(a) illustrates an embodiment in which the string tension adjustment member is attached to a general yoke section and is a cross-sectional view taken in a direction orthogonal to the longitudinal direction of the yoke section, and Fig. 4(b) is a view taken along line IVb-IVb of Fig. 4(a);

Fig. 5 is a partially enlarged perspective view of the yoke section illustrating an embodiment in which the string tension adjustment member as shown in Figs. 3(a), 3(b), and 3(c) is stored in a storage hole of a member adjacent to the yoke section;

Fig. 6(a) and 6(b) are views showing a structure of the string tension adjustment member different from that of Figs. 3(a), 3(b), and 3(c) in which a columnar member is formed by a tapered columnar member, in which Fig. 6(a) is a cross-sectional view taken in a direction orthogonal to the longitudinal direction of the yoke section with the string tension adjustment member and Fig. 6(b) is a cross-sectional view taken along line VIb-VIb of Fig. 6(a);

Fig. 7(a) and 7(b) are views showing another embodiment illustrating the structure of the string tension adjustment member using a screw mechanism in which the string tension adjustment member is attached to the yoke section, in which Fig. 7(a) is a cross-sectional view taken in a direction orthogonal to the longitudinal direction of the yoke section and Fig. 7(b) is a cross-sectional view taken along line VIIb-VIIb of Fig. 7(a);

Fig. 8 is a cross-sectional view showing another embodiment that is different from the one using the screw mechanism in Figs. 7(a) and 7(b), which is taken in a direction orthogonal to the longitudinal direction of the yoke section, and illustrating the structure of the string tension adjustment member attached to the yoke section; and

Fig. 9 is a view showing another embodiment of the string tension adjustment member having a helical shape seen from the

upper face side, and illustrating the structure of the string tension adjustment member attached to the yoke section.

## BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, embodiments of a sporting racket according to the present invention will be described with reference to the drawings, and herein, a tennis racket will be described as an example of the sporting racket.

(Embodiment 1)

As shown in Fig. 1, a racket 1 includes a loop-shaped frame body 3 having an inner region in which strings 2 are stretched in net shape to provide a hitting area Ht; a shaft section 4 having a grip section 7 gripped by a player at a tip end section thereof; a yoke section 5 partially forming the frame body 3; and a throat section 6 for connecting both ends of this yoke section 5 to the shaft section 4.

The periphery of the frame body 3 has string holes 8 that penetrate the frame body 3 from an inner peripheral face 3a to an outer peripheral face 3b so that the strings 2 are inserted back and forth therethrough. These string holes 8 (see Fig. 2) are provided at plural positions in an edge portion of the frame body 3 so as to be spaced a predetermined distance from one another. Therefore, the yoke section 5 partially forming the frame body 3 also has a plurality of string holes 8 (six string holes 8 in this embodiment) which are spaced apart a predetermined distance apart from each other

As shown in Fig. 2, in the case of the racket 1 according to the present invention, one string tension adjustment members 9 is respectively provided between string holes 8a and 8b, between string holes 8c and 8d, and between string holes 8e and 8f of the six string holes 8 (8a, 8b, 8c, 8d, 8e, 8f) provided at the center part of the yoke section 5. Each string tension adjustment member 9 is retained by the string 2 inserted to the corresponding hole.

As schematically shown in a enlarged view of Figs. 3(a), the string tension adjustment member 9 according to this embodiment entirely has a columnar shape body (one type of circular cylindrical body in this embodiment) and, has a helical screw groove 10 on an outer peripheral face thereof. The helical screw groove 10 is provided in a manner as shown in Fig. 3(a) or Fig. 3(b) showing a helical groove bottom 10b of the screw groove 10, in which the depth of the groove 10 continuously varies changed from one end to the other end of the columnar body. This screw groove 10 functions as a string-contact face.

As shown in Fig. 3 (a), the screw groove 10 in this embodiment preferably has a pitch angle $\alpha$ in the range from 8 to 16 degrees and more preferably of about 11. 5 degrees. According to the experiment by the present inventor, the above described angles are preferable because they provide the retention of the string 2 under various conditions and a range in which the string 2 can be adjusted to have a required tension. However, the pitch angle is not limited to these angles and also may be an angle near or other than these angles. The

string tension adjustment member 9 in this embodiment is made of ABS resin. Alternatively, the string tension adjustment member 9 also may be made of other resins (e.g., glass-fiber reinforced resin), wood, metals (e.g., aluminum, duralumin, titanium), or ceramics.

As shown in Fig. 1 or Figs. 4(a) and 4(b) that are a partially enlarged view thereof, the string tension adjustment member 9 shown in Fig. 3 is actually provided between the string holes 8 provided so as to be close to one another (adjacent to one another in this embodiment) in the yoke section 5 such that the string 2 is wound around the screw groove 10 of the string tension adjustment member 9 (see Fig. 3(c)), i.e., a folding section 2A of the string 2 is in contact with the screw groove 10 that functions as a string-contact face of the string tension adjustment member 9.

In this embodiment, the string tension adjustment member 9 itself is fixed to the frame body 3 of the racket 1 by the tension by the string 2.

When a player desires to change the tension of the string 2 of the racket 1 having the structure as described above (e.g., when the player desires to slightly increase the tension), the tension can be increased by inserting a commercially-available hexagonal wrench (not shown) into a hexagonal wrench hole 9B provided at a top face 9A of the string tension adjustment member 9 to rotate the string tension adjustment member 9 in a counterclockwise direction in Fig. 1 or Fig. 4(a) in this embodiment. The tension can be reduced by rotating the string tension adjustment member 9 in a clockwise direction.

Specifically, when the string tension adjustment member 9 is rotated so that the difference in distance from the string-contact face of this string tension adjustment member 9 which is in contact with the string 2 to the outer peripheral face of the frame body 3 becomes 2mm, the tension of the string 2 can be changed by about 5.7lb (2.6kgf). When the difference in the distance becomes 3mm, the tension of the string 2 can be changed by about 8.5lb (3.8 kgf). The difference in the distance of about 2mm to 3mm is sufficient for practical use.

In this embodiment, only the strings 2 in the longitudinal direction in the sweet spot area of the racket 1 among the string 2 can be adjusted to have a different tension. Alternatively, as necessary only the strings 2 in the lateral direction in the sweet spot area also may be appropriately adjusted to have a different tension. In a further alternative, the strings 2 both in the longitudinal and lateral directions may be adjusted to have a different tension.

Nonetheless, only the change in the tension of the strings 2 in the longitudinal direction in the sweet spot area can effectively adjust the tension of the strings 2 of the racket.

(Embodiment 2)

As shown in Fig. 5, another structure also may be provided, in which storage hole members 20 are provided along and adjacently to the yoke section 5 so that each storage hole member 20 has a circular cylindrical storage hole (hole for storing the string tension adjustment member) 20C to allow this storage hole 20C to perfectly store therein

the string tension adjustment member 9 except for the top face and the bottom face thereof.

In the case of the racket 1 according to Embodiment 2, all of the string tension adjustment member 9 and the folded parts of the string 2 are stored in the storage hole member 20 as shown in Fig. 5, thus providing an improved appearance. The tension of the string 2 in this embodiment is also adjusted in the manner as described above by inserting the hexagonal wrench (not shown) into the hexagonal wrench hole 9B provided at the top face 9A of the string tension adjustment member 9.

(Embodiment 3)

The string tension adjustment member 9 also may be structured such that, a tapered columnar body the head of which is cut off as shown in Fig. 6(a) and 6(b), has, at a peripheral face thereof, a screw groove 10 that functions as a string-contact face around which the string 2 is wound. In these drawings, the reference numeral 24 denotes a grommet provided between the string tension adjustment member 9 and the yoke section 5. This grommet 24 may be made of synthetic resin such as nylon or made of rubber.

(Embodiment 4)

In another embodiment in Fig. 7(a) and Fig. 7(b), the frame body 3 (including the yoke section 5) has the string tension adjustment member 9 on an outer peripheral face thereof. In the string tension

adjustment member 9 according to this embodiment, the screw mechanism 12 allows the relative movement of two wedge members 13A and 13B so that the height of a valley 14 provided between these wedge members 13A and 13B (distance from a side face of the yoke section 5) is changed, thereby changing the tension of the string 2 retained at the valley 14. In the drawings, the reference numeral 24 denotes a grommet provided between the string tension adjustment member 9 and the yoke section 5.

(Embodiment 5)

In another structure in Fig. 8, a female screw hole 15 is formed to extend from the outer peripheral face to the inner peripheral face of the frame body 3 in parallel with the string 2 so that a bolt 16 is screwed to the female screw portion 15 and a head portion 16h of this bolt 16 has a concave curved face so as to easily retain the string 2. In this structure, the tension of the string 2 is changed by allowing this head portion 16h of the bolt 16 to be relatively moved into or from the female screw hole 15. In the drawing, the reference numeral 24 denotes a grommet provided between the string tension adjustment member 9 and the yoke section 5.

(Embodiment 6)

In another structure shown in Fig. 9, the string tension adjustment member 9 has a three-dimensional helical body, the thickness of which varies continuously. In this structure, a part of

the string tension adjustment 9 which contacts the folded part of the string 2 is appropriately changed depending on a desired tension. This string tension adjustment member 9 is, of course, brought into contact with the outer peripheral face 3F (not shown) of the frame body 3 or is brought into contact with an outer face 24F of the grommet 24 as shown in Fig. 9.

Although the above embodiments have been described in terms of a racket having a yoke section, the present invention also can be applied to a racket having a yoke section or a racket having no yoke section. When the present invention is applied to a racket having no yoke section, the string hole provided in the yoke section is replaced by a string hole provided in a corresponding part of the frame body.

The above description has mainly been directed to a tennis racket. However, the present invention also can be applied to various rackets in which strings in the hitting area are stretched in a net shape, including badminton, squash, etc.

(Industrial Applicability)

The present invention is carried out in the manner as described above. According to the racket of the present invention, a simple structure can be used to change the tension of the strings in accordance with the preference of a player and in a simple and quick manner.

Furthermore, the racket according to the present invention

does not cause a substantial increase in the weight or an unbalanced appearance.